Effects of a Ready Signal on Eyelid Conditioning

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By

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The purpose of the present study was to investigate the effects of the ready signal (RS) on the eyelid conditioning. 6 groups of 12 subjects were assigned in 3 experiments in which the RS was present or absent, the CS was lengthened or not, and the visual attention was concentrated or not. Main findings were as follows: in the condition in which the RS was presented constantly 1.0 sec. prior to the CS onset, the RS inhibited significantly the CR, the RS effect differed from the ISI effect and was very similar to the effect of the visual attention or concentration.

In the study of the eyelid conditioning, it was often convenient to present a ready signal (RS) from 1.0 to 4.0 sec. prior to the administration of the CS. According to Spence & Weyant (1960), the Iowa studies of the eyelid conditioning made use of a "verbal" RS since the early experiment of Hilgard & Campbell (1936). And it seemed that the use of the RS reduced the likelihood of a random, spontaneous blink occurring in the CS-UCS interval and had the advantage of procuring greater uniformity in the organism antecedent to stimulation than was secured when no RS was used.

However, little consideration was given to the possibility that the RS was a variable which might affect the level of the conditioning until the investigation of Dufort & Kimble (1958). And McAllister & McAllister (1960 a, b), Price, Vandament & Abbott (1964), Dufort & Rollins (1965) and Turner (1966) reported that the inferior performance in the eyelid conditioning was typically found in the subjects given an RS before each trial.

The previous studies obtained the inhibitory effect of the RS from the experiments that used the auditory RS (a word "ready" and a tone or noise) and the visual CS except two experiments of McAllister & McAllister who used the auditory RS and CS. The RS-CS interval varied irregularily from trial to trial. The inhibitory effect of the RS was induced by the decrease of the CR performance in the eyelid conditioning with the RS, but the changes of the CR latency were not reported at all. And beyond this fact, little is known about the effect of the RS and no generally accepted theoretical interpretation exists even at the present day.

The associative learning theorists assume commonly that the temporal contiguity between the CS and the UCS is a necessary condition to establish the CR in the classical

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conditioning. Also in the eyelid conditioning with the RS, the CS is presented contiguously with the UCS. Therefore, it seems that the inhibitory effect of the RS is one of the elementary problems in the classical conditioning.

The primary aim of the present study was to collect the data from which a hypothesis worthy of careful study might be suggested. The three experiments reported in this paper were a step with that intention. And in order to reject the influence of the personality factors on the conditioning, the subjects were selected by means of some criteria of the personality inventory. Because a number of investigators have reported a positive relationship between the conditionability and some traits of the personality as the anxiety or the introversion-extroversion.

Experiment I

The purposes of the present experiment were to investigate the following three problems in the conditions that the RS and the CS were presented to the same visual modality and the RS-CS interval was 1.0 sec. constantly: (a) the effect of the RS on the CR performance, (b) the effect of the RS on the CR latency, (c) whether the RS effect was the lengthening effect of the CS duration or not, because the subject might accepted the RS as one of the successive compound CS prior to the UCS.

Method

Subjects and design: At the beginning of the semester, all students studing introductory psychology at Gifu University and Gifu City Women's Junior College were given the Maudsley Personality Inventory (MPI) under the guise of a "reliability" study. Fortyeight female undergraduates were selected with four criteria of the MPI scales, and requested to serve later as the subjects (*S*s) in an experiment. The criterion-scores of the MPI were as follows: 16–36 on E scale, 15–36 on N scale, at and below 20 on L scale and ?. The *S*s had little knowledge of the eyelid conditioning.

When those *S*s came to the laboratory, they were told that they had been selected from the class rolls "at random". Those *S*s were assigned serially to one of three groups. One group (Group RS) was given 60 conditioning trials with the RS, another group (Group NRS) with no RS, and the third group (Group CSL) with no RS and the lengthening CS. However, twelve *S*s were discarded for various reasons; for violating instructions, because the records were defective, because of voluntary responders and because apparatus was not in order. Consequently each group consisted of 12 female undergraduates (mean age: 19.4). The mean score of E scale and N scale of the MPI in the three groups were as follows: Group RS, 27.17, 24.17 respectively; Group NRS, 25.83, 23.92; Group CSL, 26.58, 23.33. There were no significant differences among three groups.

Apparatus and procedures: The CS was the onset of a circular light, 3.5 cm in diameter, 50 cm in front of the *S*s. The CS intensity was the brightness which did not

cause the eyeblinking by the light onset alone. And as a point of the regard, a luminous diode (4.0 v, 35 mA) was placed in the center of the milk-glass disc.

The UCS was an air-puff, delivered to the cornea of the right eye through a nozzle 1.0 mm in diameter. An air-puff nozzle was attached to one arm of the face fixed apparatus (T.K.K. universal type). The UCS intensity was approximately 2.25 g/cm^2 at a distance of 2.0 cm from the nozzle. The air-puff was generated by an air-system consisting of an air-compressor with a storage tank, a pressure-reducing valve and a solenoid-operated air valve.

The RS was the onset of a luminous diode used as a point of the regard. The onset and the duration of the stimuli, the interstimulus interval (ISI) were controlled by a Multipurpose Electronic Stimulator (Nihon Kohden MES-40).

A recording system of the eyelid response consisted of a TV camera, two televisions, a transducer which used two Cds, a DC power supply, a DC amplifier and an ink writing oscillograph. The CR was measured by using a system shown in Fig. 1.

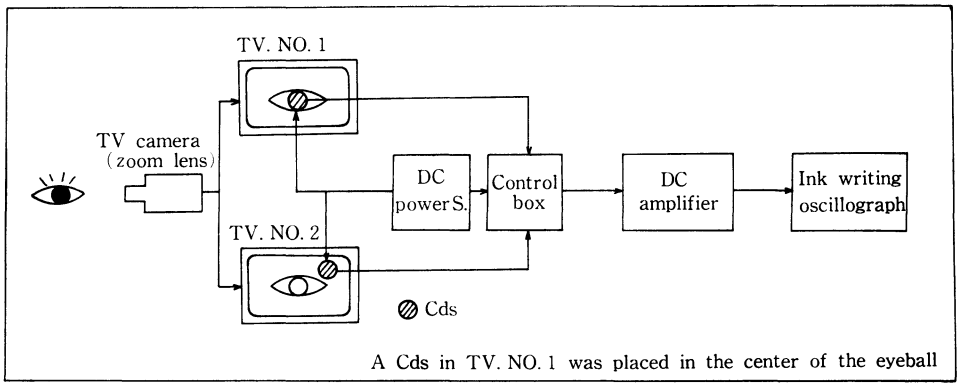

Fig. 1. A system to measure the eyelid response.

The *S*s were seated in front of the stimulus panel (80×60 cm) with their faces fixed in a light and soundtreated room. For the masking of the various noise, the weak white noise was presented through a speaker during the experiment.

Group NRS underwent 60 conditioning trials in the following procedures: the CS duration was 550 msec., the UCS duration was 50 msec. and the UCS was overlapped in the end of the CS duration. Group RS underwent also 60 conditioning trials in the same procedures with that of Group NRS except that as the procedure the RS of the duration 1.0 sec. was presented prior to the administration of the CS. And the RS-CS interval was 1.0 sec. Group CSL took 60 conditioning trials in the same procedures with that of Group NRS except that as the procedure the CS duration was 1550 msec. The intertrial intervals (ITI) were 10, 15 and 20 sec. and 20 trials in each ITI were arranged at random.

The *S*s of the three groups were told before the beginning of the conditioning,

"Make yourself comfortable, and adopt a passive and indifferent attitude toward the experiment. Watch a spot in the center of the milk-glass panel, without making effort to do a thing. Don't close your eyes voluntarily, and if you feel like closing your eyes, never prevent it".

Before the conditioning trial, the spontaneous blinkings of the *S*s were recorded for 2 or 3 min. Next, the *S*s underwent 2 test trials with the CS alone. And two UCS were given to the *S*s without the CS to record the UCR. A CR was defined as a deflection of 1.0 mm of the recording pen between 250 and 500 msec. in Group NRS and RS, between 250 and 1500 msec. in Group CSL after the CS onset. And a response that had evidently one of the spontaneous and the voluntary blinking's features was not scored as a CR.

Results and Discussion

Fig. 2 presents the percentages of the CRs for all groups in the blocks of 10 trials. The acquisition curve of Group RS was significantly lower than that of Group NRS ($F=13.35$, $df=1/22$, $p<.01$). Next, there was also a significant difference between Group NRS and Group CSL ($F=18.98$, $df=1/22$, $p<.01$). The curve of Group RS was remarkably similar to that of Group CSL.

The mean latency of the CR was shown in Fig. 3. As to the mean latency, Group RS was similar to Group NRS and different from Group CSL.

The inhibitory effect of the RS was found in the condition under which an RS was constantly given 1.0 sec. prior to the CS. However, the inferior performance of the CR was also found in Group CSL for which the CS duration was 1550 msec. From those results, the inhibitory effect of the RS seemed as an effect of the lengthening of the CS duration. Since there was, however, a difference on the latency of the CR between Group RS and Group CSL, the effect of the RS was considered to differ from that of

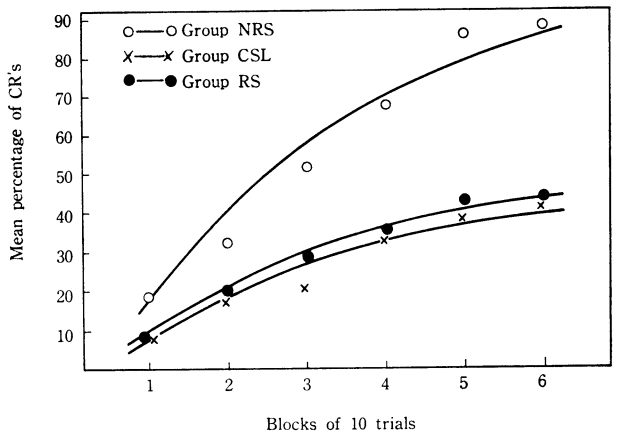

Fig. 2. Mean percentage of CRs for three groups in blocks of ten trials.

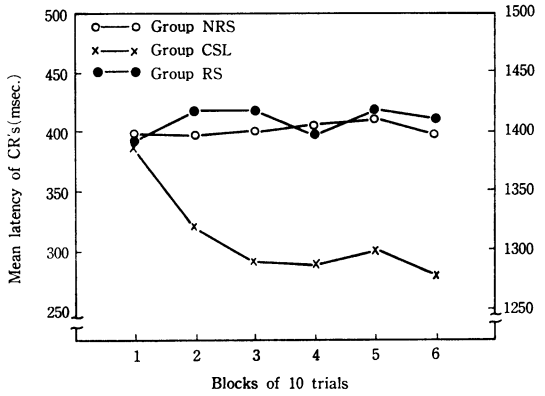

Fig. 3. Mean latency of CRs for three groups in blocks of ten trials.

the CS lengthening. Therefore, a next experiment was designed to obtain a distinct difference between the RS effect and the effect of the CS lengthening.

Experiment II

The analysis of the results in Exp. I raised a question as to the mediation process of the conditioning which had been manipulated by the use of the RS. Accordingly the experiment II employed the following procedures in order to answer this question: that is, by asking the *S*s to press a telegraph key in response to the onset of the RS or the CS during the conditioning, it was attempted to explore some aspects of the mediation processes of the conditioning with the RS and without RS.

Method

Thirty *S*s were selected by using the same procedures with that of Exp. I and assigned to either of the two groups. The *S*s in each group was requested to press rapidly a telegraph key, that is, one group (Group RS-K) for the onset of the RS, another group (Group CSL-K) for the onset of the lengthening CS. The *S*s of those groups were instructed to set free the finger on the key at the offset of the CS. Except the procedure of the key press performance, the apparatus and the other procedures were the same with that in Exp. I.

Finally, the data obtained from twelve *S*s in each group were used for analysis (mean age: 19.0). The mean score on E and N scale of the MPI in the two groups were as follows: Group RS-K, 27.92, 25.58, Group CSL-K, 27.58, 22.67. There were no significant difference between two groups.

Results and Discussion

The acquisition curves of Group RS-K and Group CSL-K are shown in Fig. 4. The analyses of the variance on those data yielded satisfactory levels of the significance

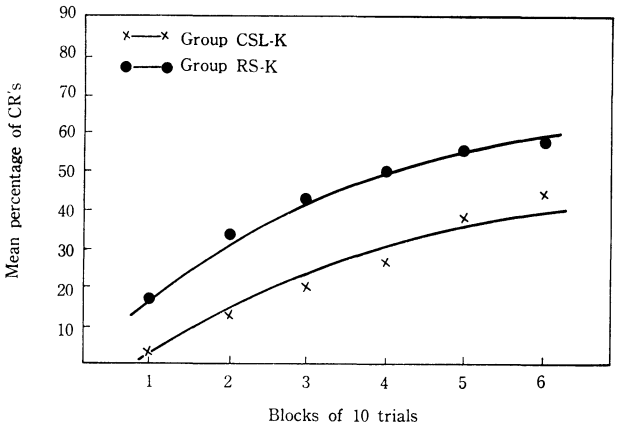

Fig. 4. Mean percentage of CRs for two groups in blocks of ten trials.

between Group RS-K and Group CSL-K through all blocks of 10 trials ($F=7.17$, $df=1/22$, $p<.05$).

On the latency of the CR, the results of the present experiment was very similar to that of Exp. I. Therefore, it seemed that the key press did not affect the CR latency.

From those results, it was considered that the effect of the key press revealed a difference between the RS effect and the ISI effect on the CR performance, and the key press had a greater effect in the RS procedure than that in the other. However, we can not explain why the RS produces the inhibitory effect. Consequently, it was necessary to examine what aspect of learning process affects the RS presentation in the following experiment.

Experiment III

A close inspection of the data in Exp. I and II suggested that the RS would serve to arouse the anticipation of the coming noxious UCS or produce a certain preparedness associated with the onset of the RS. Since such an anticipation or preparedness was brought about generally by concentrating the attention of the *S*s on the onset of the RS, the experiment III was designed to examine the effects of the visual attention toward the RS on the eyelid conditioning. The results were compared with those of Group RS and Group NRS in Exp. I.

Method

Fifteen *S*s were collected in the same procedure with that for Exp. I and II. Those *S*s were asked to watch intently a spot that became bright at random intervals (interval boundary 0.4–0.9 sec., pulse duration 500 msec.) by a Random Pulse Generator (T.K.K. Multi-Unit System). This spot was a luminous diode which had

been used as a point of the regard and the RS in the previous two experiments.

Those *S*s in the present experiment (Group VA) were instructed as follows: "Concentrate your attention as much as possible on a spot in the center of the milk glass placed in front of you". The other procedures and the apparatus were the same with those in Exp. I and II.

The analyses were carried out with the data obtained from twelve *S*s (mean age: 20.5) and the mean scores of the MPI scales were 24.75 on E scale and 23.67 on N scale. As to the mean score of E and N scale, there was no significant difference between Group VA and Group RS, Group NRS in Exp. I.

Results and Discussion

Fig. 5 shows the acquisition curves of Group VA, Group RS and Group NRS. The acquisition curve of the Group VA was very similar to that of Group RS of Exp. I and there was no significant difference between those two groups. Moreover, the acquisition curve of Group VA was significantly lower than that of Group NRS ($F=7.59$, $df=1/22$, $p<.05$).

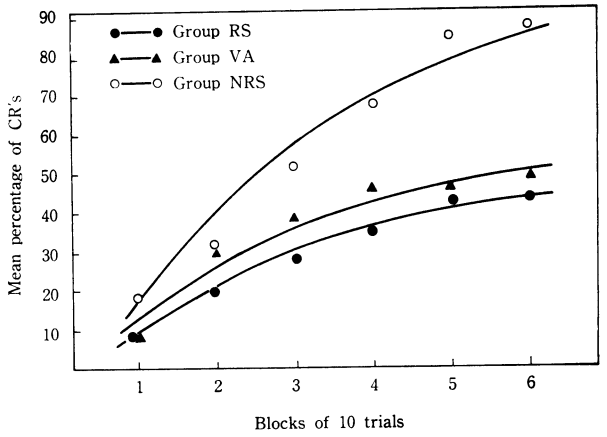

Fig. 5. Mean percentage of CRs for a group with the visual attention and two groups without the visual attention in blocks of ten trials.

The CR latencies of the three groups are presented in Fig. 6. Those results were very similar to one another.

From those results, it was suggested that the visual attention or concentration had the inhibitory effect on the acquisition processes of the CR. Those results supported the previous report of Oyamada (1971). As a point of the regard, the present experiment used a luminous diode (random luminescence) and the previous experiment used a mark on the stimulus display panel. In spite of such a procedural difference, the visual attention inhibited the performance of the CR. Therefore, it was considered

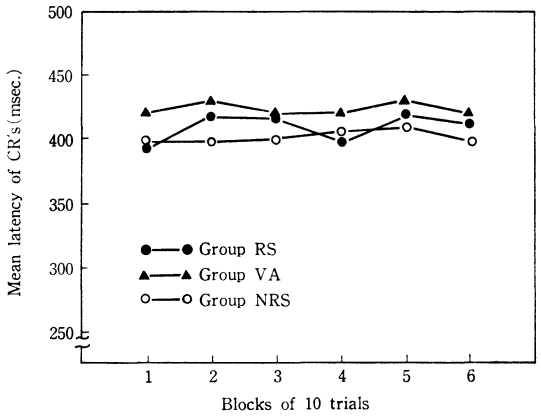

Fig. 6. Mean latency of CRs for a group with the visual attention and two groups without the visual attention in blocks of ten trials.

that there was a close relationship between the functions of the visual attention and the effects of the RS presentation.

Conclussion

In the previous studies on the effect of the RS, the RS-CS interval changed generally from 1.0 to 4.0 sec. at random. However, as the results of the present study show, even when the RS was presented constantly 1.0 sec. prior to the onset of the CS, the CR performance was inhibited.

In the eyelid conditioning, the manipulation of the RS presentation was operation ally analogous to manipulating of the length of the CS-UCS interval. And also those procedures produced similarly an inhibitory effect on the CR performance. But, as the results of Exp. II show, the task of the key press revealed the difference between the RS effect and the ISI effect. The effect of the key press on the CR performance was greater in the RS procedure than in any other procedure.

Since it seemed that the RS presentation required the *Ss* to concentrate their attention on the onset of the RS, Exp. III was designed to investigate the changes of the psychological functions that the RS presentation aroused in the organism. The visual attention or concentration had an inhibitory effect on the CR performance and had no effect on the CR latency. Those results were very similar to the effect of the RS. Therefore, it was suggested that there was a close relationship between the learning mediation process of the eyelid conditioning with the RS and that of the eyelid conditioning with the visual attention. And the following questions arose: why did the RS affect inhibitively the CR performance ? and why didn't the RS affect the CR latency ?

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